Sessions 2 and 3

Slides, Flips, and Turns

Materials

- Interlocking cubes (130 per pair)
- Students' envelopes of tetrominoes
- 10-by-12 Rectangle (1–6 per student)
- Scissors, crayons, glue (optional)
- Computers with Tumbling Tetrominoes installed
- Student Sheet 2 (1 per computer)
- Student Sheet 3 (1 per pair)
- Student Sheet 4 (1 per student, homework)
- Student Sheet 5 (1 per student, homework)

For the paper version of Tumbling Tetrominoes:

- 10-by-12 Rectangle (1 per student)
- One standard number cube
- Crayons or markers

What Happens

Students continue to explore how they can cover an area with tetrominoes. In the computer game, Tumbling Tetrominoes, they practice the three basic geometric motions—slides, flips, and turns. There are two class discussions, one about the off-computer activity, one about the computer game; you will decide the best time to hold these, depending on when students have had enough experience with the activity to reflect on the discussion questions. Their work focuses on:

- covering a rectangular region with tetrominoes of a single shape, looking for patterns and larger units
- forming conjectures as to why certain tetrominoes will cover the region completely and some will not
- giving explicit commands—slides, flips, and turns—to the computer to move tetrominoes to completely cover a rectangular region
- visualizing how one shape can be moved to best fit into a spatial arrangement of shapes

Ten-Minute Math: Broken Calculator Two or three times during Investigation 1, in a spare 10 minutes any time during your class day, use the activity Broken Calculator. This activity gives students practice in solving computation problems flexibly.

Pose problems like these:

Put 125 on your calculator screen without pressing 1 or 5.

Add 62 and 30 without pressing 3.

Add 48 and 48 without pressing 4 or 8.

After students solve the problem, list some of their solutions on the board. Ask students to choose one solution and extend it into a series that follows a pattern. For example, to form 125 without pressing 1 or 5:

$99 + 24 + 2 = 125$
$98 + 24 + 3 = 125$
$97 + 24 + 4 = 125$

For full directions and variations, see p. 53.

Activity

The Perfect Cover-Up

Distribute a copy of the 10-by-12 Rectangle to each student. They will be covering this grid with cubes as they did in Session 1, or with the paper tetrominoes they have been making. If students who want to use paper tetrominoes have not made at least 30 of the same shape, make available additional copies of the grid so they can continue coloring and cutting out tetrominoes, as they did for the Session 1 homework.

Today, you're going to try to cover a rectangle again, either with cubes or your paper tetrominoes. You can use only one shape, but as many copies of it as you need. You can slide, turn, or flip the shapes to get the best fit.

Students should find the best arrangement they can, covering as much of the rectangle as they can. Those who are using interlocking cubes can record their patterns by coloring in the squares to match the placement of the cube tetrominoes. Students using the paper cutouts can either paste them in place on the grid or color in their placement.

As you watch students work, make sure they know they can turn their shapes or flip them over. Ask questions like these:

Can you make a perfect fit? Are there many different ways to get a perfect fit? Are there strategies to get more of them to fit on the grid?

If you get a perfect fit with one shape, try to cover the rectangle with another tetromino. Which tetrominoes cover the whole rectangle perfectly?

As students work, ask questions to encourage them to recognize, expand, and reflect on their strategies:

I see you're using a pattern. Will it lead to a perfect fit if you continue to use that pattern?

Activity

Class Discussion: The Perfect Fit

This whole-class discussion will likely take place in Session 3, after all students have tried to cover the rectangle with several different tetrominoes. Ask them to share what they found out.

Which tetromino can you use to make a perfect fit? What strategy did you use to cover the rectangle? Did you use a pattern? Did you build another larger shape out of your tetromino? Which tetrominoes would not cover the rectangle? Why? Can you convince us there is no way the rectangle can be covered with that tetromino?

❖ **Tip for the Linguistically Diverse Classroom** In a discussion of this type, encourage all students to demonstrate as they share their ideas. For those who cannot yet verbalize responses, ask them to demonstrate their ideas as you narrate their actions.

The overhead projector would be useful for demonstrating students' strategies on the transparency of the 10-by-12 Rectangle. You may find that students used some of the following strategies:

- **Guess and Check** One beginning strategy is simply to place tetrominoes where they "look like" they fit, then change the placement if large holes appear. As they engage in both the off-computer and on-computer activities in these sessions, many students move beyond this and start thinking ahead, planning where each tetromino should go.
- **Patterns** Some students see that putting one tetromino "this way," then the next one "that way," in a pattern, leads to a perfect cover-up.

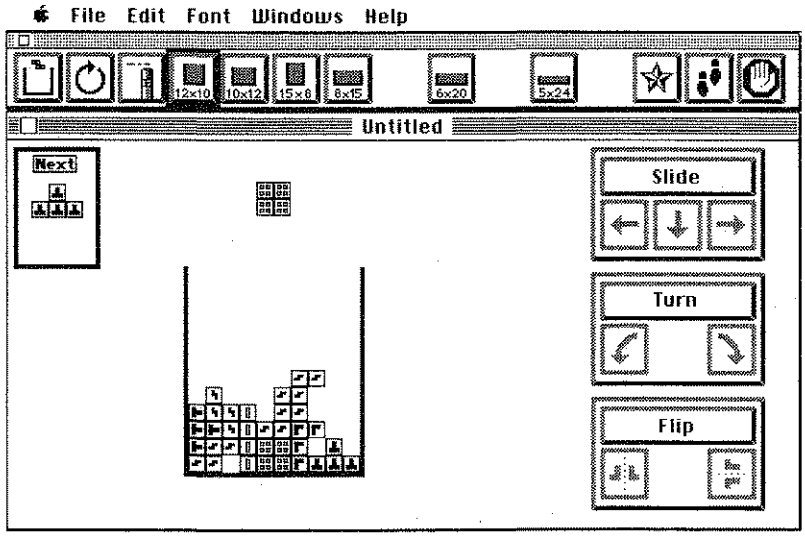
How to Play Tumbling Tetrominoes (page 1 of 2)

Cover the rectangle with tetrominoes.

First choose a motion: slide, flip, or turn. Then click on a button below to choose the direction of that motion.

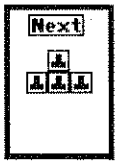
Or use the keyboard:
- S = Slide
- T = Turn
- F = Flip

Use the arrow keys to choose the direction.



If you choose Slide and hit the spacebar, the tetromino will drop quickly—but you can't change its direction.

Tetrominoes stick when they hit the bottom or when they hit another tetromino. If a tetromino is poking out the top of the rectangle when it sticks, it disappears.



The "Next" box shows you the next tetromino you will have to place. It can help you plan how to move so you don't leave holes.

Three different things can end the game:

- When three tetrominoes have poked out the top and disappeared, the game is over.
- Or when the rectangle is completely filled, the game is over.
- Or when you click on the Stop tool, the game is over.

How to Play Tumbling Tetrominoes (page 2 of 2)

When the game is over, find your score. Your score is the number of squares covering the rectangle. Write the score for each game on your Game Records.

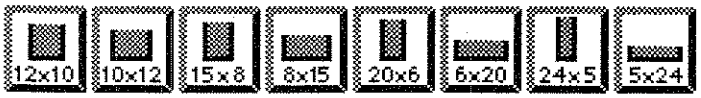
If you don't have time to finish a game, ask your teacher about saving it.

The Tool Bar

New Game Click on this to start a new game.

Replay Click on this to play your last game over again. The same tetrominoes come up in the same order.

Erase One Click on this to take away your last move.



Rectangles Click on any of these to choose the shape of the rectangle you are going to cover.

Star Level Click on this to play a harder game. You can't Flip, and you can't Erase One.

Step Click on this to walk through a game you already played, one move at a time.

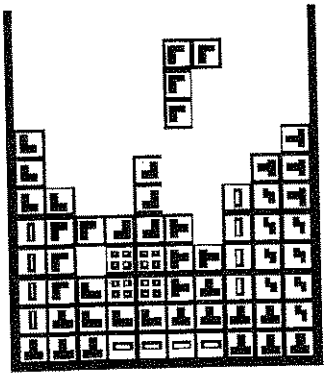
Stop Click on this to end the game.

Name

Date

Student Sheet 3

Game Records

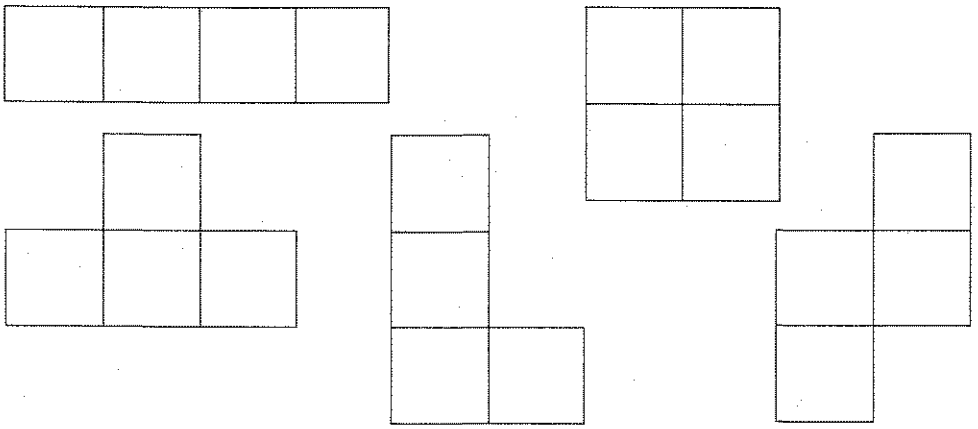


When you play Tumbling Tetrominoes on the computer, record each game on this sheet.

In the third column, write the shape of your rectangle (for example, 10 by 12).

Game number	Date	Rectangle	Score

The Perfect Cover-Up



Choose one tetromino shape. Using that shape, cover as many squares as you can on the 10-by-12 Rectangle.

You can use extra copies of the 10-by-12 Rectangle to make more copies of the shape you have chosen. Or you can color in the shapes on your rectangle.

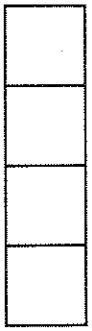
If you color each tetromino, make all the squares in one tetromino the same color. But you can use lots of colors. You could make a red tetromino, a blue tetromino, a purple tetromino, and so on.

How Many Squares?

Fill in the chart to show the number of total squares for each group of tetrominoes.

Number of tetrominoes	Number of squares
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Suppose you had a page of 72 squares. How many of the I-shaped tetrominoes would you need to cover it?



Draw a picture to show how you solved this. Also explain in writing how you figured it out.